Enhancing participation in agri-environmental schemes (AES): A Scottish case study

# Abstract

Scotland is undergoing a major period of agricultural reform, with a new agri-environmental scheme (AES) package aimed at positioning the country as a leader in sustainable and regenerative agriculture. For these reforms to succeed, farmer participation must be maximised through effective, accessible, and flexible scheme design.

A national survey of farmers and advisers was conducted to assess perceptions of current AES and identify barriers to uptake. AES were perceived to be financially risky, particularly due to uncertainty around application success and the potential consequences of non-compliance. Schemes were also seen as inflexible, with concerns centred on narrow application windows, limited control over contracted land, and rigid contract terms. While environmental awareness and social support were generally high, many respondents lacked clear information on which nature-based solutions (NbS) were appropriate for their farms. The application process was also perceived as overly complex, with poor feedback and limited communication from administering bodies.

The Scottish Government’s proposed four-tier agricultural support framework offers a structured opportunity to address these challenges. Tier 2, which provides outcome-based and universally accessible payments, has strong potential to reduce perceived financial risk while offering greater flexibility through tailored options. To enhance awareness, information-sharing, and social acceptability, Tier 4 should support voluntary, farmer-led clusters with access to public and private advisory services. To improve application clarity, a streamlined online portal is recommended, modelled on England’s Environmental Land Management (ELM) scheme, with clear, accessible guidance and built-in feedback mechanisms. These three recommendations align with the structure of the proposed support framework and directly address the key barriers identified by farmers and advisers. Their implementation would support the delivery of a more inclusive, practical, and effective AES capable of meeting Scotland’s agricultural and environmental goals.

# 1. Introduction

Agri-environmental schemes (AES) are voluntary monetary based contracts offered to farmers and land managers; compensation is provided to cover incurred costs and productivity losses when specific management practices are implemented (Ait Sidhoum et al., 2023). They reward farmers for delivering positive environmental outcomes (Schaub et al., 2023) and are a key policy tool used by governments to steer farmers to manage their land in a nature and climate friendly manner (Eichhorn et al., 2023). AES therefore play an important role in supporting agricultural transition to a more sustainable system of food production, helping to address the ‘triple challenge’ of halting and reversing biodiversity loss, achieving net-zero greenhouse gas emissions, and producing food that is nutritious, affordable, and sustainable (WWF, 2023; Tyllianakis et al., 2023).

Prior to Brexit, Scottish AES were tied to the European common agricultural policy (CAP). In total, 75% of the payments delivered from the CAP were targeted for the conventionally focussed Pillar 1 of the CAP, with payments based on the area of land farmed (Pe’er et al., 2014). Only 25% of the CAP was paid through the competitive Pillar 2 rural development fund which supported AES (Science for Environment Policy, 2017). The CAP, and the AES associated with it, have been criticised for being ineffective in transitioning food production systems to more sustainable methods and meeting the requirements for the protection of nature and climate (Pe'er et al., 2017; Pe’er et al., 2020; Cullen et al., 2021; Hurly et al., 2022; Bateman & Balmford, 2018). However, Scotland’s departure from the EU and the CAP offers an opportunity to create new agricultural policy (*Agriculture and Rural Communities (Scotland) Act 2024*). This policy shift is part of Scotland’s future vision for the agricultural sector, where it aims to become a global leader in sustainable and regenerative agriculture with a support framework that delivers high quality food production, climate mitigation and adaptation, and nature restoration (Scottish Government, 2022a). Consequently , Scotland is undergoing an agricultural support reform process which began in 2024 and will transition through to 2027. This presents an opportunity to increase the portfolio and design of AES to increase their effectiveness for delivering environmental benefits (Schaub et al., 2023).  
The new Scottish agricultural support system (Figure 1) is similar to the CAP in that it has multiple pillars or tiers with a tier 1 base payment to support continued farming. But there are marked differences with conditionalities attached to climate and nature for base payments. Furthermore, tier 2 is no longer competitive but is open to all and focussed on nature and climate. Tier 3 is competitive and in terms of environment is focussed on landscape scale nature and climate measures. The 4th tier of the proposed agriculture support package is for complementary support and is based around continuing professional development, advice, knowledge exchange and building relationships with wider support networks. It will be delivered through the Farm Advisory Service (FAS) which is part of the wider agricultural knowledge and innovation system (AKIS) that links organisations, institutions, incentives and funding to address gaps in knowledge exchange and promotes uptake of learning activities.

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Figure : The 4 tiers associated with the new Scottish agricultural support systems.

This shift in the agricultural support system signals a change in mindset where farmers and land managers are now expected to provide a greater diversity of public goods (Cusworth & Dodsworth, 2021). Public goods are non-excludable (available to all) and non-rivalrous (one person using it does not reduce its availability to others) (Buchholz and Sandler., 2021). Examples include: flood resilience, access to green space, reduced greenhouse gas emissions, clean water, improved biodiversity etc. Securing public goods from agriculture will be essential in addressing the ‘triple challenge’ (Tyllianakis et al., 2023) and transitioning to a future where nature is integrated into the food production system (Nature Friendly Farming Network, 2024).

To deliver these envisaged public goods from the new agricultural bill and agricultural support framework a significant proportion of Scottish farmers and land managers must adopt the new AES for it to be successful and effective (Canessa et al., 2024; Hurley et al., 2022). However, factors that influence AES uptake and adoption are complex (Tyllianakis and Martin-Ortega., 2021; Klebl et al., 2024’; Uthes and Matzdorf, 2013) and vary depending on the sociodemographic factors (Canessa et al., 2024). To understand the specific factors that are affecting uptake of AES in Scotland a survey was designed to evaluate how current Scottish AES are performing;, specifically the agri-environment climate scheme (AECS), nature restoration fund (NRF) and the forestry grant.

The survey was designed around the primary research question: How do farm demographics, attitudinal factors, and perceived barriers influence the uptake of Agri-Environment Schemes in Scotland? To address this question, the survey investigates four key areas. First, it explores how farm demographics, including farm type, size, location, and the socio-demographic characteristics of farmers and advisers, affect participation in AES. Second, it investigates the interplay between attitudinal factors and perceived barriers to uptake. Attitudinal factors include environmental awareness (such as knowledge of environmental challenges and the perceived importance of stewardship), risk perception (including concerns about financial or regulatory uncertainty), and social acceptance (the extent to which AES participation is encouraged by peers or the wider farming community). These attitudes often shape or are shaped by perceived barriers, such as the inflexibility of scheme requirements (e.g., rigid contracts or restrictive land management rules), challenges in accessing relevant information (including guidance on eligibility, payments, and application processes), and the clarity and consistency of communication from government agencies. Finally, by analysing how these factors interact, the study identifies key issues influencing scheme uptake and uses these insights to develop evidence-based recommendations for policymakers aimed at improving participation in future Agri-Environment Schemes.

# 2. Methods

For access to the full survey instrument please see Appendix A

## 2.1 Survey Co-design process

Co-design is increasingly recognised as a valuable approach in agri-environmental research, helping to ensure that research tools are relevant, practical, and grounded in stakeholder experience (Reed, 2008; Blackstock et al., 2012). It involves actively involving end-users, such as farmers and advisers, in shaping the research process and outputs. This survey was co-designed with input from three farmers and two agricultural advisers from the Scottish Farm and Wildlife Advisory Group (ScotFWAG). The farmers were existing contacts from previous research, while the advisers were recruited specifically for this project.

The process began with informal discussions to identify key challenges and priorities related to Scotland’s AES. These early conversations helped define the focus and structure of the survey. Based on these inputs, a pilot version of the survey was developed and shared with the same group. Farmers were visited in person on their farms to work through the pilot survey collaboratively, allowing them to ask questions and provide immediate, detailed feedback on content, structure, length, and clarity. Advisers were engaged remotely via telephone and email, they participated in initial discussions and later received the pilot and final survey drafts for comment. Their input focused on technical language, accessibility of the questions, and practical concerns about scheme relevance. The advisers helped frame the terminology used in this survey so that farmers would understand (Table 2). This iterative process allowed for several refinements, helping to ensure that the final survey was both robust and accessible. Given the ongoing reforms to Scottish AES, both farmers and advisers were motivated to contribute, which added credibility and stakeholder relevance to the design (Tyllianakis et al., 2023).

Table : Showing the interchangeable words used for the survey and project that farmers are familiar with.

|  |  |
| --- | --- |
| **Academic word** | **Words farmers can relate to** |
| Agri-environmental schemes (AES) | Environment scheme |
| Nature based solutions (NbS) | Wildlife improvements |
| Public goods | Benefits |

## 2.2 Survey structure and approach

The survey was comprised of three sections. The first section, titled *‘Getting to know you and your farm’*, aimed to gather information about both the land being farmed and the characteristics of the farmer (Figure 2). This section followed a structure commonly used in previous UK farmer surveys (e.g. McMillan et al., 2019) and was designed to categorise respondents according to key farm demographics. These questions also allowed us to assess whether the sample was broadly representative of the wider farming population. Advisers who did not farm were not required to complete this section.

Figure 2: Farming background factors found to influence farmers decision on provision of 'public goods for public money' (Mcmillan et al., 2019)

The main component of the survey was called ‘*opinion questions’* and it examined what influences farmer’s opinions of AES. A series of Likert scales were developed to facilitate this understanding. Six scales were created with several items in each scale (Table 2). The Likert scales were randomised to prevent any systematic bias of the survey design. The Likert scales and items were designed using the framework established by Canessa et al., (2024) which aims to measure the adoption of AES by covering a range of decision-making variables in a concise but thorough approach. The scales align with analogous research centred around farmers engagement with nature restoration (Jacob et al., 2023) and nature markets (Broadway initiative, 2023; GFI, 2023).

Table : Likert scales used within the survey. The construct measured is the "Likert scale" whilst the items to measure that specific construct are on the right.

|  |  |
| --- | --- |
| **Likert Scale** | **Items included in scale** |
| Environmental Awareness | I am well-informed of the environmental issues in farming |
| I know which wildlife improvements are most relevant for my local area |
| I believe adding more wildlife improvements is beneficial |
| I care for my local environment and feel a sense of stewardship |
| Social Acceptance | My community is supportive of environment schemes |
| There is no stigma attached to adopting wildlife improvements in my community |
| My family's approval motivates me to participate in environment schemes |
| Positive influences from social media shape my opinion on environment schemes |
| Risks | Adding wildlife improvements is a financial risk |
| It is risky applying for environment schemes because you might not be successful |
| Environmental schemes are risky because of potential non-compliance |
| I worry about accountability if issues arise with wildlife improvements. |
| Environmental schemes have too much contractual risk |
| Inflexibility | There is the risk of having to maintain wildlife improvements after the contract ends |
| Contract lengths are not flexible enough |
| Adding wildlife improvements feel like an irreversible decision |
| Adding wildlife improvements limits my control over land use |
| The timeframe for applying to environment schemes is inconvenient |
| Information | The cost of getting information (advisors, surveys, databases) on what wildlife improvements are suitable is reasonable |
| There is enough support to help me make decisions about environment schemes |
| Farmer meetings help me get the information I need |
| I get the information I need for environment schemes on time and it's adequate |
| Application clarity | Applying for environment schemes is simple |
| Environment scheme guidance is easy to understand |
| The language in environment schemes is easy to understand |
| Communication with environment schemes is positive and cooperative |
| Communication with environment schemes is prompt and clear. |
| Case officers from environment schemes have a good understanding of farm requirements and operation |
| Feedback from environment schemes is clear and constructive |

Likert-scale item responses were scored on a 0–5 scale (0 = Strongly disagree to 5 = Strongly agree) and aggregated to form composite measures for each attitudinal construct. The mean of item responses was calculated for each respondent, consistent with established practice when Likert data are treated as approximating interval-level properties for parametric analysis (Norman, 2010). This method preserves response variability, enables group comparisons, and supports further statistical procedures such as regression and correlation. Comparison of mean and median values revealed differences of less than 0.1, supporting the use of the mean as a robust summary statistic. Composite scores enhanced construct-level interpretation and reliability, enabling more stable and interpretable measurement of latent attitudes across items (DeVellis, 2017).

## 2.3 Survey distribution and uptake

The survey targeted farmers and agricultural advisers in Scotland, recognising that AES differ across the devolved nations of the UK. The study aimed to capture a broad range of perspectives from those involved in land management and farming, including full-time and part-time farmers, crofters, tenant farmers, owner-occupiers, and professional advisers. This diversity of respondents ensures that a wide spectrum of experiences, roles, and responsibilities in relation to AES participation are represented (Rey-Valette et al., 2017).

The survey was disseminated online via farming networks and newsletters (Table 3). The approach also recognised, however, that a substantial proportion of the farming demographic are older and that this might present barriers with regard to their engagement with online surveys. This was addressed by having paper copies of the survey at locations where the farming community converge such as auctions, markets, conferences, farmer meets, agricultural shows etc.

Table : Organisations contacted that disseminated the farmer survey and their method of dissemination.

|  |  |
| --- | --- |
| **Organisation** | **Format** |
| Northwoods partnership | Newsletter |
| ScotFWAG | Email and word of mouth |
| NFFN | Newsletter and social media |
| SRUC/SAC | Email and word of mouth |
| Scottish crofting federation | Newsletter |
| RSPB | Email and word of mouth |
| Scottish wildlife trust | Email and word of mouth |
| Loch Lomond and Trossachs national park authority | Social media |
| Cairngorms national park authority | Email and word of mouth |
| Forth rivers trust | Newsletter and social media |
| NFUS | Newsletter and email |
| Pasture for life | Members forum |
| Scottish farmers forum | Social media |
| Soil association | Newsletter |
| AFN Network+ (Agri-food for Net Zero Network) | Newsletter |
| BASE-UK | Newsletter |
| AHDB | Email and word of mouth |

## 2.4 Statistical analysis

A variety of data types were collected through the survey, including categorical, ordinal (e.g. Likert-scale items), continuous, and count data (Table 4). Given the predominance of non-normally distributed, ordinal, and count variables, non-parametric methods were primarily employed to ensure robust analysis without relying on assumptions of normality or homogeneity of variance. Associations between two categorical variables were analysed using the chi-square test of independence, used for testing relationships between nominal variables (Agresti, 2018). When the independent variable was categorical and the dependent variable was continuous, ordinal, or count-based, the Kruskal-Wallis test was applied. This non-parametric alternative to one-way ANOVA is appropriate for comparing multiple groups when data do not meet parametric assumptions (Sheskin, 2003). To assess relationships between variables where at least one was ordinal or count-based, Spearman’s rank correlation coefficient was used. This test is suitable for analysing non-parametric data and does not require the assumption of normally distributed variables, making it appropriate for survey responses such as Likert-scale items and other ranked or count-based measures (Hauke & Kossowski, 2011). Relationships between continuous-continuous or count-count variables were not examined, as they were not relevant to the study’s research questions.

Table : Statistical test used, depending on the data type combination.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Categorical | Continuous | Likert (Ordinal) | Count |
| Categorical | Chi-square + Cramer’s V | Kruskal-Wallis | Kruskal-Wallis | Kruskal-Wallis |
| Continuous | - | N/A | Spearmans Rank | Spearmans Rank |
| Likert (Ordinal) | - | - | - | Spearmans Rank |
| Count | - | - | - | N/A |

To assess the internal consistency of the Likert scales, Cronbach’s alpha was calculated for each scale. Cronbach’s alpha is a widely used reliability coefficient, used to determine whether a group of related items reliably measures a single underlying construct. It is calculated based on the average inter-item correlation among a set of items within a scale. It considers both the number of items in the scale and the average covariance between item pairs (Tavakol and Dennick, 2011).   
In this study, each Likert scale reflected a distinct attitudinal theme relevant to AES uptake, such as risk perception, environmental awareness, information availability and application clarity. Each scale included multiple items, individual statements rated by respondents on a 5-point Likert scale, designed to capture different dimensions of that theme. For example, the risk perception scale included items about AES competitiveness, non-compliance concerns, and financial uncertainty.

Cronbach’s alpha produces a coefficient between 0 and 1, where higher values indicate stronger internal consistency among the items within a scale. A high alpha score suggests that the items are closely related and likely measuring the same underlying idea. For instance, if respondents who agree that " Environmental schemes have too much contractual risk " also tend to agree that "Environmental schemes are risky because of potential non-compliance," this indicates a consistent pattern across the risk-related items. Conversely, a low alpha would suggest that the items are not well-aligned or may reflect multiple unrelated ideas. While interpretation thresholds can vary, a commonly accepted threshold is 0.7 or above for acceptable reliability, although values above 0.6 can be considered acceptable in exploratory research (Tavakol and Dennick, 2011).

Applying Cronbach’s alpha in this study served two key purposes. First, it provided a statistical check to confirm that the items grouped within each scale were conceptually aligned and measuring a coherent construct. This is particularly important for attitudinal data, where consistency among responses strengthens the validity of interpreting scale scores. Second, it supported the rigour of the co-designed survey. Although the items were developed through consultation with farmers and advisers, and informed by previous studies, reliability testing ensured that the resulting scales were not only contextually relevant but also methodologically robust. This improved confidence on the use of these scales in subsequent analysis that explored what influences farmer engagement with AES.

# 3. Results

This section presents the findings from the survey, organised into four parts. First, a descriptive overview of respondents and their land is provided, covering key farm demographics and respondent characteristics. Second, the results from the Likert-scale items are presented, offering insights into attitudes, perceptions, and barriers related to AES participation. Third, internal consistency of the Likert-scale groupings is assessed using Cronbach’s alpha. Finally, statistical tests of association explore relationships between farm and demographic variables and the attitudinal and barrier-related responses, as well as associations within individual sections of the survey.

## 3.1 Getting to know you and your farm

In total, 80 survey responses were received: 38 from farmers; 25 from advisers; and 17 from advisers who also farm. The majority of respondents were university educated (80%). Most respondents were male (67%). In terms of location, most responses were attributed to the east central region (23%) while 13% of responses indicated ‘*Scotland’,* which represents advisers who work across multiple regions (Figure 3).

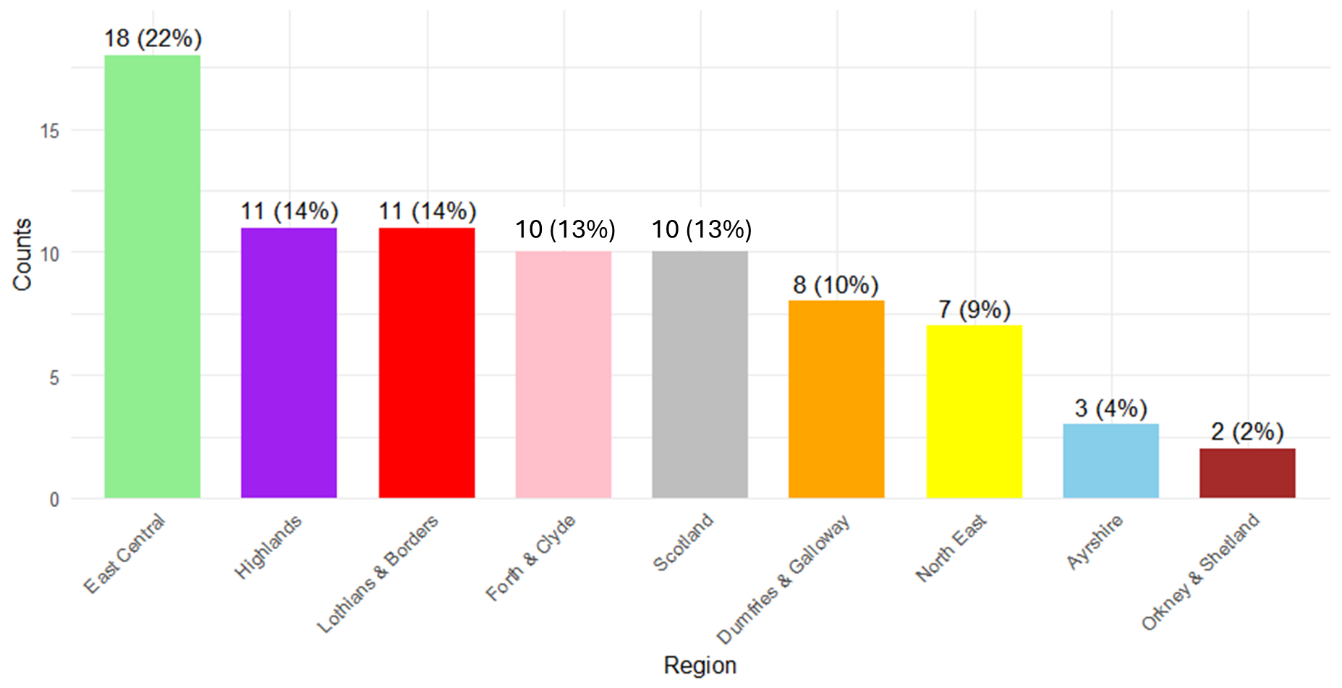


Figure : Where respondents primarily farm or advise, bar plot showing count data along the x axis and percentages for each region.

The most common farming activity, reported by the majority of farm enterprises, was livestock agriculture (58%), followed by crop production (27%), with woodland management being the least common (15%). Overall, 63% of farmers stated that they farmed on less favoured areas (LFA) status land. With regard to ownership, 71% of the farmers owned their farms, 15% were tenants and 15% had mixed ownership/tenureship. The median farm size was 140 hectares with a few very large (i.e. > XXX ha) land holdings responding. Within the survey responses, 47% of farmers indicated that they are currently engaged in an AES. Most farmers and advisors who farm accommodated a few wildlife improvements (NbS) on their land, with several respondents having >5 NbS on their land (Figure 4a). The most common wildlife improvement on farms was grassland managed for nature followed woodland planting and hedgerow planting/restoration. The least common wildlife improvements were those that required large investments of resources such as restoring natural rivers and the construction of rural sustainable drainage systems and also those specific to certain land types (i.e., moorland management) (Figure 4b).

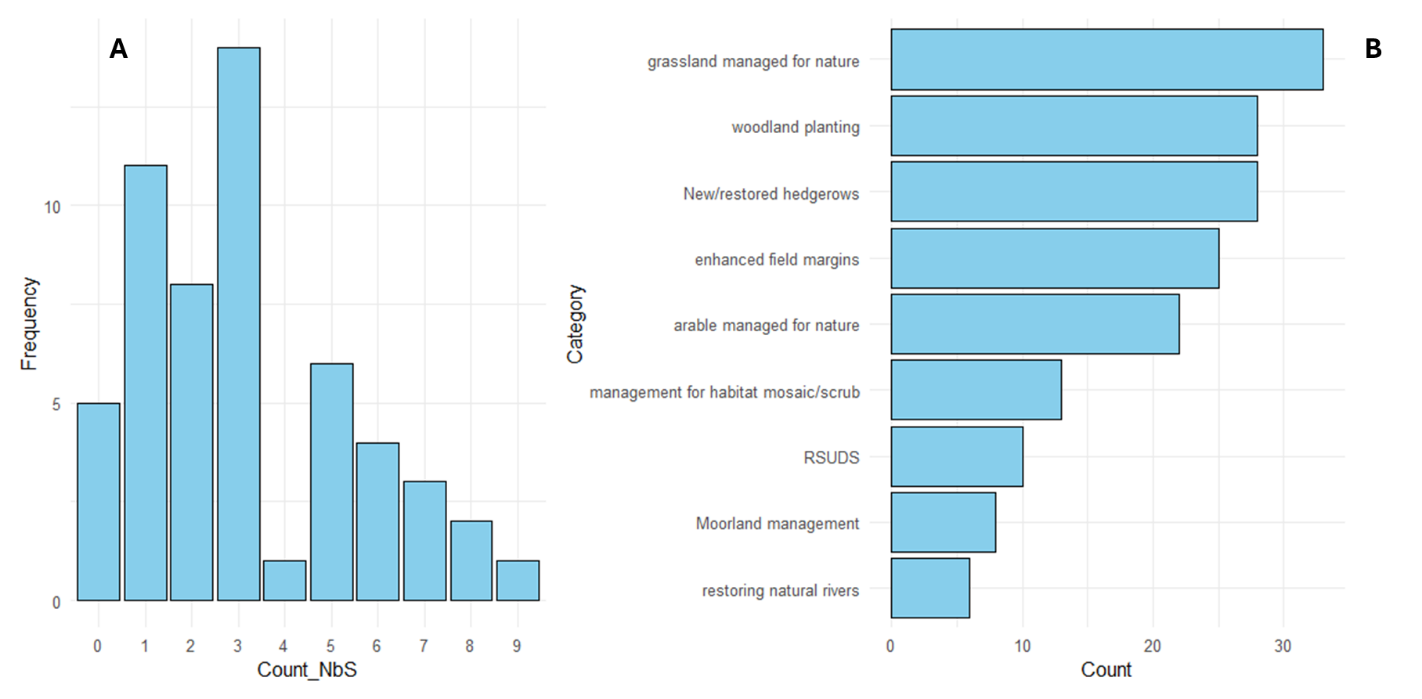


Figure : The left histogram shows count data for the number of NbS on each farm. The right histogram shows the count data for each type of wildlife improvement on the farms.

The final question of this section asked farmers ‘How important are the following reasons for your decision to farm’ (Figure 5). All the options were important for farmers, though some more so than others. Stewardship of the land emerged as a key theme, with ‘looking after the countryside’ and ‘keeping the land in good heart’ rated as very important by the majority of respondents. This aligns with the commonly discussed view of farming as more than just an occupation. While for some, it may reflect a lifestyle preference, given that over half of respondents found ‘enjoying the farming way of life’ to be very important, for others, it may be more strongly shaped by intergenerational succession and family obligation rather than a freely made career choice.

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Figure : Likert scales showing how important various reasons are for farming.

## 3.2 Likert Scales

A series of Likert scale responses provided an overview of the attitudinal factors and perceived barriers affecting AES (Figure 6). Respondents reported high levels of self-perceived awareness of environmental issues, with over 84% agreeing or strongly agreeing with each of the four statements in the environmental awareness scale (Figure 6a). These statements covered topics such as being informed about environmental issues in farming, believing in the benefits of adding wildlife improvements, caring for the local environment, and feeling a sense of environmental stewardship. The highest agreement was observed for items relating to environmental care and stewardship, with 93% of respondents indicating agreement or strong agreement. However, one item stood out: when asked whether respondents knew which wildlife improvements were most relevant for their local area, only 28% strongly agreed, significantly lower than the average of 59% for the other three items (Fig 6a).

Responses to the scale measuring social acceptance of AES were more varied than those for environmental awareness, with a notable proportion of participants choosing neutral responses, averaging 31% across all 4 items (Fig. 6b). Overall, respondents tended to agree that their local community is supportive of environmental schemes, that there is no stigma associated with adopting wildlife improvements, and that family approval acts as a motivating factor. For these three items, the average proportion selecting “agree” or “strongly agree” was 42%, compared to 15% who disagreed or strongly disagreed. However, the item addressing the influence of social media on opinions about AES showed a much more divided pattern: 22% of respondents agreed and 22% disagreed, with a higher proportion strongly disagreeing (11%) than strongly agreeing (5%).

The Risks of AES scale measured how strongly respondents associated AES participation with different types of risk. For all five items in the scale, selecting “agree” or “strongly agree” indicated a higher level of concern or perceived risk, while “disagree” or “strongly disagree” reflected lower concern. On average, just over half of respondents (53%) perceived an overall moderate to high risk associated with AES, with 15% strongly agreeing and 38% agreeing. In contrast, only 19% expressed low concern (16% disagreeing, 3% strongly disagreeing), while 24% gave neutral responses (Fig. 6c). The highest perceived risks were related to uncertainty and potential consequences: many respondents agreed that applying for AES is risky because success is not guaranteed, that non-compliance could lead to penalties, and that they could be held personally accountable if issues arose from wildlife improvements. A second tier of concerns focused on contractual complexity and the financial risks associated with implementing wildlife measures.

Responses to the inflexibility scale, where agreement indicated greater perceived inflexibility and disagreement indicated perceived flexibility, suggest that many participants viewed AES as rigid in their structure. When averaging across four of the five items in the scale, excluding the item about whether adding wildlife improvements feels irreversible, 43% of respondents agreed or strongly agreed, while only 14% disagreed or strongly disagreed (Fig. 6d) The strongest concerns centred on three key areas: inconvenient application timeframes (33% agree/strongly agree), inflexible contract lengths (54%), and the risk of having to maintain wildlife improvements after contracts end (47%). These items reflect a clear sense of procedural and long-term constraint. Perceptions were more mixed regarding loss of control over land use, with 34% agreeing but 27% disagreeing, indicating a more divided view. The clearest departure from this overall pattern was in response to the statement that “adding wildlife improvements feels like an irreversible decision”—here, 43% of respondents disagreed or strongly disagreed, making it the only item in the scale where rejection outweighed agreement.

The information accessibility scale produced a mixed pattern of responses, reflecting neither strong satisfaction nor widespread dissatisfaction among participants (Fig. 6e). Averaging across the first three items, concerning the cost of obtaining information (e.g., from advisors, surveys, or databases), the availability of support for decision-making, and whether information is received in time and is adequate, 35% of respondents agreed or strongly agreed, 23% were neutral, and 30% disagreed or strongly disagreed. These results suggest that while a portion of respondents found information provision around AES to be reasonable and supportive, a comparable share felt that it fell short in terms of timeliness, cost-effectiveness, or adequacy. In contrast, responses to the final item “Farmer meetings help me get the information I need” were notably more positive: 58% agreed or strongly agreed, while only 19% disagreed or strongly disagreed.

Responses to the application clarity scale showed that many participants found the process of engaging with AES confusing or difficult. In this scale, disagreement with a statement reflects a perception of poor clarity. On average, 46% of respondents disagreed or strongly disagreed, while only 14% agreed or strongly agreed, indicating generally low satisfaction with how clear and accessible the application process is (Fig. 6f). The most negatively rated aspects were the simplicity of applying and the clarity of guidance documents. For these two items, 72% and 59% of respondents, respectively, disagreed or strongly disagreed that the process was straightforward.

Other items in the scale received slightly less negative but still concerning responses. For example, 47% of respondents disagreed that the language used in AES materials is easy to understand. Communication was also a common source of frustration: 42% felt that communication with schemes is not prompt or clear, and 30% disagreed that it is positive and cooperative. Similarly, 40% said that feedback from AES is not clear or constructive, and 31% disagreed that case officers understand farming needs and operations.

Many of these communication-related items also had relatively high “don’t know/prefer not to say” response rates, averaging 22%. This likely reflects the fact that fewer than half of respondents were actively involved in an AES, limiting their direct experience with these elements.



Figure : Responses for each of the Likert scales from the survey respondents with legend beneath. Add on a, b, c, d, e, f and refer to these in the text to aid the reader.

## 3.3 Cronbach Alpha

To test the internal consistency of the Likert scale items, Cronbach’s alpha scores were calculated for each of the attitudinal factors and perceived barriers. These reliability scores indicate how well the items within each Likert scale measured a common underlying concept. Higher values suggest greater internal consistency. Social acceptance and Information scales have a moderate score (>0.6) whilst environmental awareness and inflexibility have high scores (>0.7) whilst application clarity has a very high score (>0.8) (Table 5).

Table : Showing Likert scales with associated Cronbach’s Alpha scores.

|  |  |  |
| --- | --- | --- |
| **Likert scale** | **Cronbach Alpha score** | **Number of Items** |
| Environmental awareness | 0.74 | 4 |
| Social acceptance | 0.63 | 4 |
| Risk | 0.76 | 5 |
| Inflexibility | 0.72 | 5 |
| Information | 0.64 | 4 |
| Application clarity | 0.86 | 7 |

During the data cleaning stage, two items were reassigned from the Information scale to the Application Clarity scale. The items; *‘Applying for environment schemes is simple’* and *‘Environment scheme guidance is easy to understand,* demonstrated both low corrected item-total correlations (r.cor < 0.4) and low item-total correlations (r.drop < 0.3) when included in the Information scale. These values indicated that the items were not strongly associated with the other items in that scale and were therefore not internally consistent with the construct being measured.

In contrast, the other items in the 'Information' scale had acceptable item-total correlation values (r.drop > 0.3), suggesting they were conceptually and statistically coherent as a group. The two items selected for reassignment differed substantively in focus, addressing perceived clarity and ease of scheme application, rather than the accessibility or quality of informational resources. Moving them to the Application Clarity scale, which better matched their content, led to stronger internal consistency in both scales, helping ensure that each set of items measured a single, coherent idea.

## 3.4 Relationships Between Respondent Profiles, Perceived Barriers, and Attitudes Toward AES

### Associations between social acceptance of AES and farm(er) characteristics

Statistical tests examining associations between social acceptance of AES and farm(er) characteristics revealed several significant patterns. Social acceptance was significantly lower among farmers compared to advisers (P = 0.007). Among farmers, higher levels of perceived social acceptance were associated with a greater number NbS implemented on their farms (P = 0.03). In addition, tenant farmers reported lower social acceptance of AES than owner-occupiers (P = 0.026). A positive correlation was observed between high social acceptance and the presence of more NbS on farms (Figure 9a-c).

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Figure : Plots associated with the social acceptance of AES. Top left = Social acceptability of AES vs whether the respondent farms or not. Top right = Social acceptability of AES vs whether the ownership structure of the farm. Bottom = Scatter plot showing social acceptability of AES vs the number of NbS on the farm.

### Associations between environmental awareness and farm(er) characteristics

A series of farm and respondent characteristics were examined for their association with levels of perceived environmental awareness. Respondents with a university-level education reported significantly higher environmental awareness compared to those educated to high school or college level (P = 0.001). Environmental awareness was also lower among farmers and advisers who actively farm, compared to advisers who do not farm (P = 0.03). This may relate to differences in educational background (Figure 8C). The heatmap presents the association between education level and whether respondents currently farm or manage agricultural land. Farmers and farming advisers were significantly less likely to hold a university degree than non-farming respondents, and more likely to report college or high school as their highest level of education (P = 0.0002, Cramér’s V = 0.36). The coloured residuals indicate where the observed frequencies differ most from what would be expected by chance: blue cells show fewer responses than expected, and red cells show more. Among farmers, higher levels of environmental awareness were associated with a greater number of nature-based solutions (NbS) present on their farms (P=0.034) (Figure 8a-d).

A screenshot of a graph

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Figure : Plots associated with awareness of environmental issues. Top left = box plot showing education level against environmental awareness. Top right = Environmental awareness against whether the respondent farms or not. Bottom left = Heatmap showing level of education vs whether the respondent farms or not. Bottom right = Scatterplot showing number of NbS on a farm on the y axis vs environmental awareness on the x axis.

### Associations Between Perceived Inflexibility and risk of AES and Farm(er) Characteristics

Perceptions of inflexibility in agri-environment schemes (AES) varied across different respondent groups. Advisers perceived AES as more inflexible than farmers, indicating a higher level of concern about scheme rigidity among advisers (P = 0.004). Among farmers, those who were currently engaged in AES perceived greater inflexibility than those not participating in a scheme at the time of the survey (P = 0.02). Established farmers also viewed AES as more inflexible compared to new entrants to farming (P = 0.003). In addition, farmers who perceived AES as more inflexible tended to have fewer nature-based solutions (NbS) implemented on their farms. Similarly, Farmers who perceived AES to be highly risky had less NbS on their farms (P = 0.04) (Figure 11a-e).

A diagram of different types of graphs

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Figure :.Plots associated with ……. A = Boxplot showing Inflexibility of AES vs whether the respondent work as an adviser, B = Boxplot showing Inflexibility of AES vs whether the farm is engaged in an environment scheme. C = Boxplot showing Inflexibility of AES vs whether the farmer is a new entrant or not. D = Scatter plot showing flexibility of AES against number of NbS on a farm. E= Scatter plot showing how perceived risk of AES changes with the count of Nature based solutions on a farm.

### Associations Between Perceived Application Clarity of AES and Farm(er) Characteristics

Perceptions of AES application clarity differed across respondent groups. Advisers reported lower application clarity than farmers, suggesting they view the process as more complex or difficult (P = 0.008). Among farmers, however, those currently participating in AES perceived application clarity to be lower than those not involved in a scheme (P = 0.02). In addition, farmers with larger land holdings reported lower levels of application clarity compared to those with smaller holdings. Farmers already engaged in AES had more NbS on their farms (P = 0.001, Chi squared = 10.83) (Figure 12a-c).

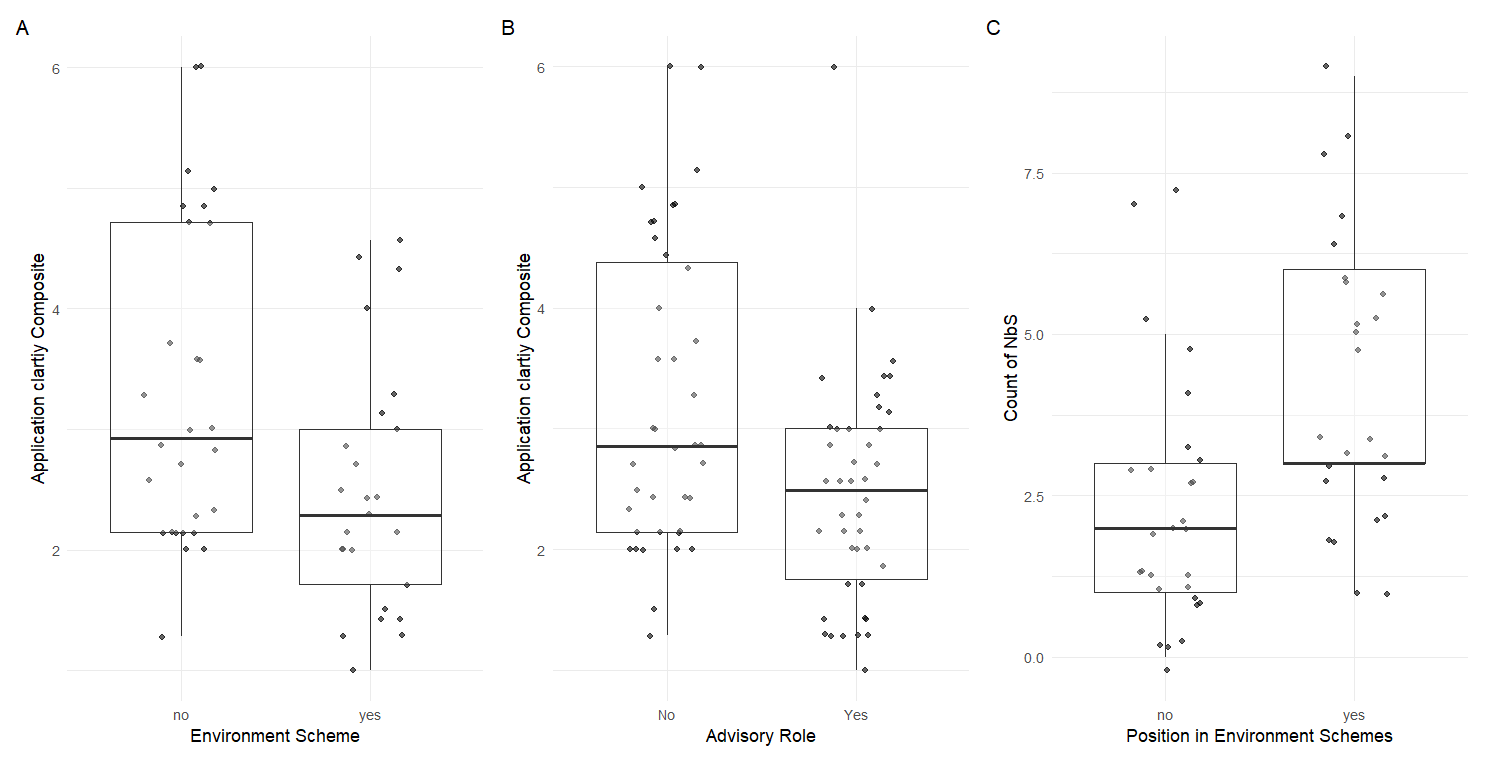


Figure : Plots associated with …..A = Boxplot showing application clarity vs whether the farmer is engaged in an environment scheme. B = Boxplot showing application clarity vs whether the respondent works as an adviser. C = Boxplot showing how the count of NbS on a farm differs with whether the farmer in engaged in an environment scheme or not.

# 4. Discussion

Our survey of farmers and advisers provides new insight into the social and structural factors that shape engagement with AES and the adoption of NbS on farms. By examining both attitudinal dimensions, such as environmental awareness and social acceptance, and perceived barriers including risk, inflexibility, and application clarity, this study offers a more comprehensive understanding of the behavioural context in which AES operate. Importantly, we found that perceptions of AES vary systematically by role, experience, and farm characteristics, and that these perceptions are closely linked to on-farm environmental action. These findings address a critical knowledge gap in understanding the non-financial drivers of AES participation. As agricultural policy in Scotland undergoes a major transition under the Agriculture and Rural Communities (Scotland) Act 2024, and with changes to the Scottish agricultural support system on the horizon, our results underscore the importance of designing schemes that are not only technically robust, but also socially acceptable, accessible, and clearly communicated. Below, we reflect on the implications of these findings in the context of ongoing policy reform.

## 4.1 Social acceptability, information and education

The social acceptability of AES plays an important role in farmers’ decision-making (Dessart et al., 2019) and can significantly influence their willingness to engage with and participate in AES (Eichhorn et al., 2024; Lastra-Bravo et al., 2015). This may be why the farmers in this survey who had greater social acceptance of AES had more NbS on their farms. Respondents generally perceived the social acceptance of AES to be high, with both family and community support viewed as important for promoting engagement with AES. This is encouraging as the opinions and experiences of farmers’ peers and local community affect their decision-making (Burton and Paragahawewa, 2011; Emery and Franks, 2012) and influence their willingness to adopt AES (Defrancesco et al., 2008).  
However, our findings also revealed a divide: tenant farmers perceived AES to be less socially accepted than owner-occupiers. This is probably due to tenant farmers often facing reduced autonomy over land use decisions, limited lease durations, and uncertainty about long-term land access, which can restrict their capacity or willingness to engage with AES (Mills et al., 2019; Mills et al., 2021).

Enhancing social acceptance among farmers could be a valuable strategy for increasing participation in AES. While family and community support were widely recognised as positive drivers of engagement in this study, responses to social media as a source of influence were more polarised. Although social media platforms have the potential to foster pro-environmental attitudes and facilitate knowledge exchange among farmers (Zhou et al., 2021), they can also introduce conflicting narratives, misinformation, or social comparison pressures that reduce trust and motivation (Zhang et al., 2021). Nevertheless, social media may still support engagement with AES by enabling farmers to share experiences, build digital credibility, and influence peers; functions that could complement more traditional, place-based forms of trust-building and communication (Soulignac et al., 2025).

An awareness of environmental issues is an important component in the adoption of AES (Klebl et al., 2024; Lastra-Bravo et al., 2015) and is closely linked to ideas of farm stewardship which has been shown to encourage sustainable farm practices and adoption of AES (Tankosić et al., 2023). The respondents in this survey already care for their local environment and feel a sense of stewardship, which is an important step in engaging farmers with AES (Dessart et al., 2019; Canessa et al., 2024). Furthermore, respondents felt they were well informed about the environmental issues that cut across farming and believed that adding NbS was beneficial. This combination of environmental awareness and stewardship may explain the observed correlation between farmers with high environmental awareness and the increasing amount of NbS on their farms.  
However, when respondents were asked if they knew which NbS were most relevant for their local area there was less certainty. This may be tied to disparities in the level of education and environmental awareness between those respondents who farmed and those who do not. To address this gap, educating farmers about NbS may offer an effective approach for promoting the engagement of AES and increasing the provision of public goods (Zindler et al., 2024). The majority of research (Wilson and Hart, 2000; Okumah et al., 2021; Dessart et al., 2019) shows a positive link between environmental awareness and AES participation. However, some studies, like Schaub et al. (2023), found no relationship, which may be because, as shown in a meta-analysis, payments can reduce farmers’ personal motivation to protect the environment, leading some who care about it to choose not to take part.

The better informed a farmer is, the more likely they are to participate in AES (Lastra-Bravo et al., 2015) and to remain actively involved with AES ([Morris, 2006](https://www.sciencedirect.com/science/article/pii/S1462901115300058?via%3Dihub" \l "bib0170)) which will likely lead to changes in farm systems and practices (Pannell et al., 2006). Therefore, investing in farmer education can also improve access to information, which was identified in this study as an area of current AES design that could be improved. Providing this education via training and advice can enhance farmer’s perception and participation of AES (Schaub et al., 2023; Tankosić et al., 2023). Analogous studies have found that this information is best received when it includes practical guidance on implementation and is tailored to the farmer (Klebl et al., 2024). The level of information a farmer has about the structure, requirements, and outcomes of AES can significantly influence their perceptions of risk and uncertainty, particularly around scheme complexity, compliance obligations, and the likelihood of success (Whitten et al., 2013; Dessart et al., 2019; Canessa et al., 2024).

## 4.2 Risk and inflexibility

Farm businesses face a wide range of risks, from market volatility to weather and climate change, which naturally makes farmers risk-averse (Vollenweider et al., 2011). In our survey, farmers perceived the overall risk of applying for and participating in AES to be high, viewing it as another potential threat to their farm business. This may help explain why those who saw AES as more risky tended to have fewer nature-based solutions (NbS) on their farms. Reducing this perceived risk is therefore crucial for increasing farmer participation in AES (Eichhorn et al., 2024). The reason for this high perceived risk is that current AES in Scotland are competitive meaning applicants run the risk of putting time and resources into an application and then failing to be accepted. If the farmer is accepted onto the AES then they face a mixture of regulatory and contractual responsibilities, which results in uncertainty around payments (Cardwell. 2023). This is likely why the two highest perceived risks from the respondents in this survey were relating to application success uncertainty and non-compliance. This combination of insecurity before and during AES implementation can negatively affect AES participation (Bartkowski et al., 2019). The respondents in this survey also perceived AES to be too financially risky, which plays an important role in the decision-making process of engaging with AES (Sattler and Nagel, 2010; Riley, 2016; Zindler et al., 2024).

Risk and inflexibility of AES are strongly linked, e.g., AES contracts that are flexible may increase participation of more risk-averse farmers (Schaub et al., 2023). Building flexibility within AES has been identified as key to securing benefits for farm businesses and the environment at both the farm and landscape scale (Nature Friendly Farming Network, 2024). Respondents believed current AES are too inflexible with the main issues stemming from the timeframe for applying, control of land, and contracts, all of which negatively affect AES participation (Mettepenningen et al., 2013). Again, we see a disparity between respondents who farm and those who do not with higher perceived inflexibility for farmers. Furthermore, we see that those established farmers and those currently engaged in AES had perceived AES to be less flexible than new entrants and those not engaged. This suggests that as farmers progress through their careers and engage with AES they increasingly perceive them to be less flexible. This is important because these negative experiences erode institutional credibility and affect AES participation ([Sutherland et al., 2013](https://www.sciencedirect.com/science/article/pii/S1462901115300058?via%3Dihub" \l "bib0220)).  
Farmers prefer AES and their measures to be less restrictive and more flexible ([Ruto and Garrod. 2009)](https://www.sciencedirect.com/science/article/pii/S1462901115300058?via%3Dihub#bib0210) which could be why those farmers who perceived Inflexibility to be high had less NbS on their farms. Providing more flexibility of the AES through a range of different levels of AES engagement and associated payment levels may encourage the participation of AES by allowing farmers to take on what they feel comfortable with (Lastra-Bravo et al., 2015). However, tailoring each AES down to the individual farm is not feasible and so there needs to be a broad enough range of flexible measures that encompass the different farming landscapes and businesses found in Scotland (van der Ploeg and Ventura 2014; Klebl et al., 2024)

## 4.3 Application clarity

The clarity of the AES application process was perceived by respondents to be poor and there seems to be two compounding reasons for this. Firstly, respondents find the application process difficult to understand, complex and inaccessible, all of which act as barriers to participation in AES (Birge et al., 2017; Tankosić et al., 2023 ;Canessa et al., 2024). Farmers are more likely to participate in AES when the process is easy and does not ‘cost’ them much in terms of time and resources (Lastra-Bravo et al., 2015). The current AES process has a heavy bureaucratic load which acts as a barrier to participation (Ruto and Garrod, G., 2009; Bartkowski et al., 2023). Simplifying and making the application guidance more accessible will help to remove this barrier.

Secondly, as reflected in the survey responses, those who successfully navigated the initial stages of the application process often encountered further frustration due to unclear communication and a lack of constructive feedback from the administering body. These two compounding factors are probably why those farmers engaged in AES perceived application clarity to be worse than those not engaged and why advisers, who are often the individuals dealing with the AES application on behalf of the farmers, find application clarity to be worse than farmers. Improving this communication can build farmer’s trust in AES (Sander et al., 2024) and over time can reshape farmers attitudes to be more positive towards AES (Riley., 2016). This combination of issues with the application process was emphasized in a recent consultation regarding future changes to Scottish agriculture where it was highlighted that current support is insufficient and there are gaps in delivery (Scottish Government**,** 2023).

## 4.4 Survey reliability

Farmers and advisers are notoriously time poor, so it was not feasible to gather a large group for a pilot study that could robustly check the Cronbach alpha of the Likert scales beforehand. Instead, the focus was placed on ensuring that the questions were appropriately framed and that all relevant areas of interest were covered, while keeping the survey duration under 10 minutes to avoid respondent fatigue. This was especially important as responses were being collected in busy public settings such as livestock auctions and agricultural shows, where a balance needed to be struck between the reliability of the Likert scales and the overall length of the survey.  
The internal consistency of the Likert scales, as indicated by Cronbach’s alpha scores, was acceptable given the exploratory nature of this study. In the context of social research aimed at identifying patterns rather than drawing definitive conclusions, moderate reliability levels are considered sufficient (Chan and Idris, 2017). The relatively lower alpha values observed for the social acceptance and information accessibility scales likely reflect the small number of items within these constructs—each consisting of only four statements. This aligns with established psychometric research showing that reliability tends to increase with the number of items, as the influence of individual item variance decreases in longer scales (DeVellis, 2012).

Most respondents were educated to university level, which is notably higher than the Scottish baseline of 33% (National Records of Scotland, 2024). This skew toward higher education levels is likely explained by the relatively high number of agricultural advisers in the sample, a professional group typically requiring formal qualifications. The majority of respondents were male, reflecting the broader gender distribution within Scottish agriculture, where 60% of farmers are male and 40% are female (Scottish Government. 2021).

A large proportion of respondents were located in East Central Scotland, likely influenced by in-person survey collection at a farming event held in Fife, which yielded particularly high response rates. All in-person recruitment events were held within approximately a one-hour radius of Central Scotland, contributing to the limited representation from more distant regions such as the Northeast and Ayrshire. Crofters and new entrants also appear to be underrepresented in the sample, as indicated by the low number of responses from these groups.

In terms of farm characteristics, the respondent group appears broadly representative of the wider Scottish farming population. A significant number operated livestock-based enterprises in Less Favoured Areas, which reflects the dominant land use classification in Scotland (NFUS. 2025). Most respondents owned their farms, aligning with national patterns where 78% of land is owner-occupied and 22% is tenanted (Scottish Government. 2013). The median farm size reported was also close to the national average of 104 hectares (Scottish Government. 2023). Approximately 20% of Scottish farmers are currently enrolled in the Agri-Environment Climate Scheme (AECS) (NatureScot. 2023), and while participation data for other AES was unavailable, uptake among this sample appears to be above average.

Overall, the respondent population can be considered broadly representative of Scottish farmers and advisers, with a slight overrepresentation of individuals already engaged in AES and a location bias consistent with the use of both in-person and online survey methods.

# 5. Conclusion and Recommendations

This study has identified a range of farm demographic characteristics, attitudinal factors, and perceived barriers that influence participation in AES in Scotland. These findings provide valuable insight into why some farmers and land managers engage with AES while others do not, highlighting specific areas where policy and support mechanisms can be improved. In total, three key recommendations are proposed along with supporting evidence. Together, these recommendations offer a roadmap for delivering more targeted, flexible, and accessible schemes that better align with the realities of Scottish farming, ultimately supporting wider uptake and the successful delivery of environmental outcomes.

## Recommendation 1: Farmer led clusters

To address the issues associated with education, information, and social acceptance highlighted in Section 4.1, an enhanced fourth tier of the support package is recommended (Figure 1). This tier should be upgraded to provide a framework for the development of voluntary, farmer-led clusters across Scotland, building on the already established framework (GWCT, 2018). Direct financial and economic support for these farm clusters can be channelled through the 4th tier of the support package to enable their growth and continual development. To facilitate these groups, access to local and trusted advisory and technical support for the farm groups should be available. Further support from government agricultural extension services, NGOs, farmer organisations etc can then be integrated into this support package for the farmer clusters (Lastra-Bravo et al., 2015). This combination of public and private information and advice will increase farmers trust and knowledge of AES (Unay Gailhard et al.,2012) which will feed into greater participation (Tyllianakis et al., 2023).

Once established, farmer clusters can evolve to identify and co-produce the types of information and training most relevant to their specific farm systems and local landscapes, with help from external support. This collaborative approach helps to address key knowledge gaps, such as understanding which NbS are most effective in local conditions, how to navigate AES requirements, and where to access reliable guidance. It also fosters trust between farmers, advisers, policymakers, and environmental organisations by creating spaces for peer learning, shared decision-making, and open dialogue (Taylor and van Grieken, 2015). The farm clusters can then choose how they want the knowledge delivered, e.g., farm visits and walks, demonstration farms, meetings and show days, workshops etc. Empowering whole farming communities creates a snowball effect where neighbouring farmer’s experiences and opinions influence others behaviour towards AES (Rodríguez-Entrena and Arriaza, 2013). These positive experiences affect farmers willingness to engage with AES and reflects their growing confidence in being able to adapt to a system that suits them best (Lastra-Bravo et al 2015).

If effective, farmer clusters should act as catalysts for information exchange, enhancing environmental awareness of farmers (Lastra-Bravo et al., 2015) and making information accessible for all farmers (Ducos et al., 2009). Building these clusters with local farm communities at their heart will promote local social capital, which is a key factor in the adoption of AES (Burton and Schwarz, 2013; Burton and Paragahawewa, 2011; Lastra-Bravo et al., 2015). Social capital supports the development of trust, reciprocity, and shared expectations among farmers, creating a more enabling environment for knowledge exchange and collective action (Sutherland and Burton, 2011; Riley, 2016). It also helps reduce uncertainty, as farmers are more likely to engage with schemes that are endorsed and normalised within their peer networks (Marshall, 2009). Furthermore, these clusters can enhance the social acceptability of AES by facilitating interpersonal communication and collaboration between farmers (Unay Gailhard et al., 2012; Tyllianakis et al., 2023), which has been shown to be positively associated with higher levels of participation (Schaub et al., 2023).

Enabling farmers to engage and shape the objectives, methods and final outcome of AES is a powerful form of co-design (Hurley et al., 2022) that can bridge the priorities of farmers and AES policy implementers (Canessa et al., 2024). So, it is encouraging that the Scottish Government is engaging with the farmer-led climate groups as this will lead to better results by lowering uncertainties, policy oversights and knowledge asymmetries (Blokamp, 2018). To ensure the long term effectiveness of the new Scottish AES it is crucial that the farm clusters are involved in its design ([Whittingham, 2011](https://www.sciencedirect.com/science/article/pii/S1462901115300058?via%3Dihub" \l "bib0225)). If done correctly this process may further enhance AES participation by promoting engagement of the farmers who have traditionally been ‘harder to reach’ (Hurley et al., 2022) whilst also building buy in and trust in the final AES design ([Mettepenningen et al., 2013](https://www.sciencedirect.com/science/article/pii/S1462901115300058?via%3Dihub#bib0165); Canessa et al., 2024). Enhancing the social capital and acceptability of AES by having farmers working together at a landscape scale will also be important for Scotland’s regional land use partnerships**.** Collaboration across neighbouring farms can help deliver landscape wide improvement to nature and climate (Tyllianakis and Martin-Ortega, 2021; Westerink et al.,2017) and facilitate AES participation (Schaub et al., 2023). Furthermore, it may open future options for blended finance options (Rodgers and Kendall. 2023). But this process needs to be done correctly and transparently to avoid farmers being unsure about collaboration which can negatively affect AES participation (Villamayor-Tomas et al., 2019, 2021).

These farm clusters will intersect with some of the key themes that the new agricultural knowledge and innovation system (AKIS) is trying to establish (ClimateXChange. 2023). Creating farm clusters at appropriate landscape or catchments levels will help intersect national policies with regional demands. Furthermore, having farmers lead and co-design the clusters will support peer to peer learning and farmer collaboration. Finally, the farmers can identify the key opportunities and upskilling they need and then can select from the options presented in AKIS such as monitor and demonstration farms, ambassador farmers field schools, mentoring etc. These farm clusters share similarities with the Environmental Clusters proposed by AKIS (ClimateXChange, 2023); however, a key distinction is that farm clusters follow a bottom-up, farmer-led approach. This empowers farmers to make decisions and helps build trust in AES and wider governmental institutions.

## Recommendation 2: Removing risk and inflexibility from AES

Risk, and especially financial risk, needs to be removed from AES. The proposed agriculture support package from the Scottish Government offers a good starting point. Having a Tier 1 base level direct payment tied to sustainable farming behaviours, restoring the environment, animal health and welfare and safeguarding fair work ensures minimum standards and cross compliance (Figure 1). The reduced risk then comes from the tier 2 enhanced level direct payments that are universally accessible and deliver outcomes for nature and climate. Furthermore, tier 2 addresses flexibility by being outcome based which means that farmers can select from several different packages each with multiple measures to suit their needs whilst still achieving the goals set. Tier 3 will be a competitive and non-universal based around elective payments for specific habitats or species. At least half of all the funding for this new agricultural support package will be directed towards actions with outcomes which support climate mitigation, adaptation, and biodiversity gain (Scottish Government**,** 2024). However, the distribution of funding between these 4 tiers suggests that 70% of the total funding for agriculture will be allocated to the least ambitious tiers 1 and 2 with 70% of that going towards the universal entry-level payments (Scottish Government, 2025). This distribution of funding may not be enough to secure the levels of AES participation required for futureproofing food production against the impacts of the climate and nature crises (NFFN, 2025; Scottish Wildlife Trust**,** 2017). However, others have suggested that ensuring active farming alongside business support is the critical issue which supports the current funding split (NFUS, 2018; Royal Society of Edinburgh, 2024). It is recommended that the data and thought process behind the funding distribution of the four tiers should be made publicly available so that independent assessments can be made about how much funding is needed within each tier to meet Scotland’s nature and climate targets whilst also securing financial stability for farmers and sustainable food production.

As a side note, information is still lacking on variable contract lengths (NFUS, 2018) and regionalised adaptation of the new AES which are important considerations (Zindler et al., 2024). It is presumed the latter will be delivered through regional land use partnerships (Scottish Government. 2022b).

## Recommendation 3: Improving application clarity

Creating AES that are not overly complex with a simple application process and straightforward guidance has been identified as essential for the future of the Scottish agricultural support system (NatureScot, 2022; NFUS, 2018). Furthermore, the application process, communication and appeals process needs to be transparent, fair and consistent which will give confidence to farmers who wish to apply (Scottish Land & Estates, 2022). It is suggested that a system similar to the English Environmental Land Management (ELM) scheme be followed. The ELM application process aims to make the experience as smooth and straightforward as possible with an online portal, accessible and easy to understand guidance, and automation which creates an average processing time of 15 days (DEFRA**,** 2024a). This has resulted in higher participation rates across all the AES offered. Additionally, results from farmers who were surveyed about their experience of the ELM’s sustainable farming incentive (SFI) highlighted that 75% of research participants found it ‘very easy’ or ‘quite easy’ to apply and 81% of farmers that took part in research rated the existing SFI offer positively (DEFRA**,** 2024b). Creating an application process like this in Scotland will help to establish a streamlined and lean bureaucratic system where communication is transparent and timely which will break down barriers to participation (Cusworth & Dodsworth, 2021) so that farmers can hit the ground running when the new agricultural support package starts in 2027.  
It is worth noting, however, that whilst the agricultural reform board and their reform route map has provided clear signposting to farmers and advisers on when the new AES will come into effect, farmers are still lacking sufficient detail on the payment system and the practicalities of implementation (Royal Society of Edinburgh, 2024)

# References

Agresti, A. (2018) Statistical Methods for the Social Sciences. 5th edn. Harlow: Pearson. Chapter 8: Contingency Tables and the Chi-Squared Test, pp. 256–290.

Agriculture and Rural Communities (Scotland) Act 2024. Available at: <https://www.legislation.gov.uk/asp/2024/11> (Accessed: 26 February 2025).

Ait Sidhoum, A., Canessa, C., & Sauer, J. (2023). Effects of agri-environment schemes on farm-level eco-efficiency measures: Empirical evidence from EU countries. Journal of Agricultural Economics, 74(2), 551–569. https://doi.org/10.1111/1477-9552.12520

Bateman, I. J., & Balmford, B. (2018). Public funding for public goods: A post-Brexit perspective on principles for agricultural policy. Land Use Policy, 79, 293–300. <https://doi.org/10.1016/j.landusepol.2018.08.022>

Barnes, A. P., Toma, L., & Hall, C. (2013). Comparative analysis of farmer participation and institutional arrangements for agri-environmental schemes in Scotland. Journal of Environmental Management, 121, 50–59. <https://doi.org/10.1016/j.jenvman.2013.02.019>

Bartkowski, B., Beckmann, M., Bednář, M., Biffi, S., Domingo‐Marimon, C., Mesaroš, M., Schüßler, C., Šarapatka, B., Tarčak, S., Václavík, T. and Ziv, G., 2023. Adoption and potential of agri‐environmental schemes in Europe: Cross‐regional evidence from interviews with farmers. People and Nature, 5(5), pp.1610-1621.

Blackstock, K.L., Kelly, G.J., & Horsey, B.L. (2012). Developing and applying a framework to evaluate participatory research for sustainability. Ecological Economics, 73, 6–14.

Blokamp, E. (2018). The promise of co- design for public policy. Australian Journal of Public Administration, 77(4), 729–743.

Broadway initiative. (2023). THE STATE OF UK NATURE MARKETS 2023.

Burton, R.J. and Paragahawewa, U.H., 2011. Creating culturally sustainable agri-environmental schemes. Journal of Rural Studies, 27(1), pp.95-104.

Burton, R.J. and Schwarz, G., 2013. Result-oriented agri-environmental schemes in Europe and their potential for promoting behavioural change. Land use policy, 30(1), pp.628-641.

Canessa, C., Ait-Sidhoum, A., Wunder, S., & Sauer, J. (2024). What matters most in determining European farmers’ participation in agri-environmental measures? A systematic review of the quantitative literature. Land Use Policy, 140. <https://doi.org/10.1016/j.landusepol.2024.107094>

Chan, L.L. and Idris, N., 2017. Validity and reliability of the instrument using exploratory factor analysis and Cronbach’s alpha. International Journal of Academic Research in Business and Social Sciences, 7(10), pp.400-410.

Cho, E. and Kim, S., 2015. Cronbach’s coefficient alpha: Well known but poorly understood. Organizational research methods, 18(2), pp.207-230.

ClimateXChange (2023) Establishing an Agricultural Knowledge and Innovation System. Available at: <https://www.climatexchange.org.uk/wp-content/uploads/2023/09/cxc-establishing-an-agricultural-knowledge-and-innovation-system-june-23.pdf> (Accessed: 12th March 2025).

Cusworth, G., & Dodsworth, J. (2021). Using the ‘good farmer’ concept to explore agricultural attitudes to the provision of public goods. A case study of participants in an English agri-environment scheme. Agriculture and Human Values, 38(4), 929–941. <https://doi.org/10.1007/s10460-021-10215-z>

Defrancesco, E., Gatto, P., Runge, F. and Trestini, S., 2008. Factors affecting farmers’ participation in agri‐environmental measures: A Northern Italian perspective. Journal of agricultural economics, 59(1), pp.114-131.

Department for Environment, Food & Rural Affairs (DEFRA), 2024a. From application to agreement: making the process to join SFI simple. [online] Available at: <https://defrafarming.blog.gov.uk/2024/03/14/from-application-to-agreement-making-the-process-to-join-sfi-simple/> [Accessed 6 March 2025].

Department for Environment, Food & Rural Affairs (DEFRA), 2024b. Stats you need to know about the Sustainable Farming Incentive. [online] Available at: <https://defrafarming.blog.gov.uk/2024/05/03/stats-you-need-to-know-about-the-sustainable-farming-incentive/> [Accessed 6 March 2025].

DeVellis, R.F. (2012). Scale Development: Theory and Applications (3rd ed.). Sage Publications.

Ducos, G., Dupraz, P. and Bonnieux, F., 2009. Agri-environment contract adoption under fixed and variable compliance costs. Journal of environmental planning and management, 52(5), pp.669-687.

Emery, S.B. and Franks, J.R., 2012. The potential for collaborative agri-environment schemes in England: Can a well-designed collaborative approach address farmers’ concerns with current schemes?. Journal of Rural Studies, 28(3), pp.218-231.

Game & Wildlife Conservation Trust (GWCT), 2018. A farmer's guide to cluster groups. Available at: <https://www.gwct.org.uk/media/658045/farmer-clusters-guide.pdf> [Accessed 10 Mar. 2025].

Hauke, J. and Kossowski, T. (2011) ‘Comparison of values of Pearson’s and Spearman’s correlation coefficients on the same sets of data’, Quaestiones Geographicae, 30(2), pp. 87–93. DOI: 10.2478/v10117-011-0021-1.

Holstead, K. L., Kenyon, W., Rouillard, J. J., Hopkins, J., & Galán-Díaz, C. (2017). Natural flood management from the farmer’s perspective: criteria that affect uptake. Journal of Flood Risk Management, 10(2), 205–218. https://doi.org/10.1111/jfr3.12129

Hurley, P., Lyon, J., Hall, J., Little, R., Tsouvalis, J., White, V., & Rose, D. C. (2022). Co-designing the environmental land management scheme in England: The why, who and how of engaging ‘harder to reach’ stakeholders. People and Nature, 4(3), 744–757. https://doi.org/10.1002/pan3.10313

Jacob, M., Rolfe, J., Jacob Associates Pty Ltd, M., Nic Lansdell Associate Director, A., Jacob Jeremy Cheesman Director, M., & Jacob John Rolfe, M. (2023). Review of the Agriculture Biodiversity Stewardship Pilots to inform the Nature Repair Market A Report by. www.marsdenjacob.com.au

Klebl, F., Feindt, P. H., & Piorr, A. (2024). Farmers’ behavioural determinants of on-farm biodiversity management in Europe: a systematic review. In Agriculture and Human Values (Vol. 41, Issue 2, pp. 831–861). Springer Science and Business Media B.V. <https://doi.org/10.1007/s10460-023-10505-8>

Lastra-Bravo, X. B., Hubbard, C., Garrod, G., & Tolón-Becerra, A. (2015). What drives farmers’ participation in EU agri-environmental schemes? Results from a qualitative meta-analysis. Environmental Science & Policy, 54, 1–9. <https://doi.org/10.1016/j.envsci.2015.06.002>

Loewenthal, K.M. (2001). An Introduction to Psychological Tests and Scales (2nd ed.). Psychology Press.

Marshall, G.R., 2009. Social capital, local institutions, and participation in watershed management. International Journal of the Commons, 3(1), pp.128–152.

Mcmillan, J., Barnes, A., Thomson, S., Spencer, M., Hopkins, J., Sutherland, L.-A., & Wardell-Johnson, D. (2019). Farmer Responses to Brexit: Intentions to deliver more “public goods for public money.” <https://www.ruralpayments.org/publicsite/futures/topics/inspections/all-inspections/cross-compliance/>

Mettepenningen, E., Vandermeulen, V., Delaet, K., Van Huylenbroeck, G. and Wailes, E.J., 2013. Investigating the influence of the institutional organisation of agri-environmental schemes on scheme adoption. Land use policy, 33, pp.20-30.

Mills, J., 2012. Exploring the social benefits of agri-environment schemes in England. Journal of Rural Studies, 28(4), pp.612-621.

Mills, J., Gaskell, P., Courtney, P., Chiswell, H., Cusworth, G., Short, C., Reed, M., & Lobley, M. (2019). Social Indicators for Agri-environment Schemes – Evidence Review. [PDF]. University of Gloucestershire.

Mills, J., Chiswell, H., Gaskell, P., Courtney, P., Brockett, B., Cusworth, G., & Lobley, M. (2021). Developing Farm-Level Social Indicators for Agri-Environment Schemes: A Focus on the Agents of Change. Sustainability, 13(14), 7820. <https://doi.org/10.3390/su13147820>[MDPI+1Research Repository+1](https://www.mdpi.com/2071-1050/13/14/7820?utm_source=chatgpt.com)

Morris, C., 2006. Negotiating the boundary between state-led and farmer approaches to knowing nature: an analysis of UK agri-environment schemes. Geoforum, 37(1), pp.113-127.

National Farmers' Union Scotland (NFUS), 2018. Steps for change. [PDF] Available at: <https://www.nfus.org.uk/userfiles/images/Policy/Brexit/STEPS%20FOR%20CHANGE%20March%202018%20-%20for%20email.pdf> [Accessed 6 March 2025].

National Records of Scotland, 2024. Scotland's Census 2022: Education, Labour Market and Travel to Work. [online] Available at: https://www.scotlandscensus.gov.uk/2022-results/scotland-s-census-2022-education-labour-market-and-travel-to-work/ [Accessed 14 May 2025].

Nature Friendly Farming Network (NFFN), 2024. Roadmap to a better food and farming future.

Nature Friendly Farming Network (NFFN), 2025. Scotland's new farming deal falls short on nature and climate ambition. [online] Available at: <https://www.nffn.org.uk/resources/scotlands-new-farming-deal-falls-short-on-nature-and-climate-ambition> [Accessed 6 March 2025].

NatureScot, 2022. Piloting an Outcomes-Based Approach in Scotland (POBAS) Project – Phase 1 Report. Available at: <https://www.nature.scot/doc/piloting-outcomes-based-approach-scotland-pobas-project-phase-1-report> [Accessed 7 March 2025].

NatureScot, 2023. Scotland's Agri-Environment and Climate Scheme - Summary. [online] Available at: https://www.nature.scot/doc/scotlands-agri-environment-and-climate-scheme-summary [Accessed 14 May 2025].[NatureSc](https://www.nature.scot/doc/scotlands-agri-environment-and-climate-scheme-summary?utm_source=chatgpt.com)

Norman, G. (2010). Likert scales, levels of measurement and the “laws” of statistics. Advances in Health Sciences Education, 15(5), 625–632.

National Farmers Union Scotland, 2025. Scottish Farming Facts. [online] Available at: https://www.nfus.org.uk/farming-facts.aspx [Accessed 14 May 2025].

Okumah, M., Martin-Ortega, J., Chapman, P.J., Novo, P., Cassidy, R., Lyon, C., Higgins, A. and Doody, D., 2021. The role of experiential learning in the adoption of best land management practices. Land Use Policy, 105, p.105397.

Pannell, D.J., Marshall, G.R., Barr, N., Curtis, A., Vanclay, F. and Wilkinson, R., 2006. Understanding and promoting adoption of conservation practices by rural landholders. Australian journal of experimental agriculture, 46(11), pp.1407-1424.

Reed, M.S. (2008). Stakeholder participation for environmental management: A literature review. Biological Conservation, 141(10), 2417–2431

Rodgers, C., & Kendall, H. (2023). Implementing Landscape-scale Environmental Management: Landscape Enterprise Networks. Journal of Environmental Law, 35(1), 87–108. <https://doi.org/10.1093/jel/eqac020>

Royal Society of Edinburgh, 2024. Agriculture and Rural Communities (Scotland) Bill. Available at: <https://rse.org.uk/programme/advice-paper/agriculture-and-rural-communities-scotland-bill/> [Accessed 7 March 2025].

Riley, M., 2016. How does longer term participation in agri-environment schemes [re] shape farmers’ environmental dispositions and identities?. Land use policy, 52, pp.62-75.

Ruto, E. and Garrod, G., 2009. Investigating farmers' preferences for the design of agri-environment schemes: a choice experiment approach. Journal of environmental planning and management, 52(5), pp.631-647.

Sander, A., Ghazoul, J., Finger, R. and Schaub, S., 2024. Participation in individual and collective agri-environmental schemes: a synthesis using the theory of planned behaviour. Journal of Rural Studies, 107, p.103255.

Sattler, C. and Nagel, U.J., 2010. Factors affecting farmers’ acceptance of conservation measures—A case study from north-eastern Germany. Land use policy, 27(1), pp.70-77.

Schaub, S., Ghazoul, J., Huber, R., Zhang, W., Sander, A., Rees, C., Banerjee, S., & Finger, R. (2023). The role of behavioural factors and opportunity costs in farmers’ participation in voluntary agri-environmental schemes: A systematic review. Journal of Agricultural Economics, 74(3), 617–660. <https://doi.org/10.1111/1477-9552.12538>

Scottish Government, 2013. Scottish Agricultural Tenure Evidence Review. [online] Available at: https://www.gov.scot/publications/scottish-agricultural-tenure-evidence-review/ [Accessed 14 May 2025].

Scottish Government, 2021. Results from the Scottish Agricultural Census: June 2021. [online] Available at: https://www.gov.scot/publications/results-scottish-agricultural-census-june-2021/pages/4/ [Accessed 14 May 2025].

Scottish Government, 2022a. Next step in delivering our vision: Scotland as a leader in sustainable and regenerative farming. Available at: https://www.gov.scot/publications/next-step-delivering-vision-scotland-leader-sustainable-regenerative-farming/documents/ (Accessed: 26 February 2025).

Scottish Government, 2022b. Regional Land Use Partnerships: Phase 1 Process Evaluation - Final Report. Available at: https://www.gov.scot/publications/regional-land-use-partnerships-phase-1-process-evaluation-final-report/documents/ [Accessed 10 Mar. 2025].

Scottish Government, 2023. Agriculture Bill - Analysis of Consultation Responses. [online] Available at: <https://www.gov.scot/publications/agriculture-bill-analysis-consultation-responses/documents/> [Accessed 6 March 2025].

Scottish Government, 2024. Agricultural Reform Programme Route Map. [online] Rural Payments and Services. Available at: <https://www.ruralpayments.org/topics/agricultural-reform-programme/arp-route-map/> [Accessed 6 March 2025].

Scottish Government, 2025. New Deal for Agriculture: First Minister's speech - 7 February 2025. Available at: https://www.gov.scot/publications/new-deal-for-agriculture-nfus-first-ministers-speech [Accessed 7 March 2025].

Sutherland, L.A. and Burton, R.J., 2011. Good farmers, good neighbours? The role of cultural capital in social capital development in a Scottish farming community. Sociologia Ruralis, 51(3), pp.238-255.

Rodríguez-Entrena, Macario, and Manuel Arriaza. "Adoption of conservation agriculture in olive groves: Evidences from southern Spain." Land Use Policy 34 (2013): 294-300.

#Route2050 2022 Update. Available at: <https://www.scottishlandandestates.co.uk/sites/default/files/inline-files/%23Route2050%202022%20Update%20%28Press%29%20%282%29.pdf> [Accessed 7 March 2025].

Riley, M., 2016. How does longer term participation in agri-environment schemes [re] shape farmers’ environmental dispositions and identities?. Land use policy, 52, pp.62-75.

Scottish Wildlife Trust, 2017. Land stewardship policy. [PDF] Available at: <https://scottishwildlifetrust.org.uk/wp-content/uploads/2017/06/FINAL_Land-Stewardship-Policy_07-ONLINE.pdf> [Accessed 6 March 2025].

Sheskin, D.J. (2003) Handbook of Parametric and Nonparametric Statistical Procedures. 3rd edn. Boca Raton, FL: CRC Press. Chapter 14: The Kruskal-Wallis One-Way Analysis of Variance by Ranks, pp. 507–524.

Soulignac, V., Pinet, F., Bodelet, M., & Gross, H. (2025). The use of digital social media in agriculture. International Journal of Agricultural and Environmental Information Systems, 16(1). <https://www.researchgate.net/publication/387729841>

Taylor, B.M. and Van Grieken, M., 2015. Local institutions and farmer participation in agri-environmental schemes. Journal of Rural Studies, 37, pp.10-19.

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach’s alpha. International Journal of Medical Education, 2, 53–55.

Tyllianakis, E., Martin-Ortega, J., Ziv, G., Chapman, P. J., Holden, J., Cardwell, M., & Fyfe, D. (2023). A window into land managers’ preferences for new forms of agri-environmental schemes: Evidence from a post-Brexit analysis. Land Use Policy, 129. <https://doi.org/10.1016/j.landusepol.2023.106627>

Unay Gailhard, I., Bavorova, M. and Pirscher, F., 2012. The influence of communication frequency with social network actors on the continuous innovation adoption: Organic farmers in Germany.

van der Ploeg, J.D. and Ventura, F., 2014. Heterogeneity reconsidered. Current opinion in environmental sustainability, 8, pp.23-28.

Villamayor-Tomas, S., Sagebiel, J. and Olschewski, R., 2019. Bringing the neighbors in: A choice experiment on the influence of coordination and social norms on farmers’ willingness to accept agro-environmental schemes across Europe. Land use policy, 84, pp.200-215.

Villamayor-Tomas, S., Sagebiel, J., Rommel, J. and Olschewski, R., 2021. Types of collective action problems and farmers’ willingness to accept agri-environmental schemes in Switzerland. Ecosystem Services, 50, p.101304.

Westerink, J., Jongeneel, R., Polman, N., Prager, K., Franks, J., Dupraz, P. and Mettepenningen, E., 2017. Collaborative governance arrangements to deliver spatially coordinated agri-environmental management. Land Use Policy, 69, pp.176-192.

Wilson, G.A. and Hart, K., 2000. Financial imperative or conservation concern? EU farmers' motivations for participation in voluntary agri-environmental schemes. Environment and planning A, 32(12), pp.2161-2185.

Whittingham, M.J., 2011. The future of agri‐environment schemes: biodiversity gains and ecosystem service delivery?. Journal of applied ecology, 48(3), pp.509-513.

# Appendix A

A close-up of a document

AI-generated content may be incorrect.

A close-up of a paper

AI-generated content may be incorrect.

A screenshot of a questionnaire

AI-generated content may be incorrect.

A screenshot of a questionnaire

AI-generated content may be incorrect.

A close-up of a questionnaire

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AI-generated content may be incorrect.

A close-up of a questionnaire

AI-generated content may be incorrect.

A screenshot of a computer

AI-generated content may be incorrect.

A white background with black dots

AI-generated content may be incorrect.

A close-up of a questionnaire

AI-generated content may be incorrect.

A close-up of a questionnaire

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A white sheet with black text

AI-generated content may be incorrect.

A close-up of a questionnaire

AI-generated content may be incorrect.

A close-up of a questionnaire

AI-generated content may be incorrect.

A screenshot of a questionnaire

AI-generated content may be incorrect.

A questionnaire with many questions

AI-generated content may be incorrect.